*Interview:*

# Energy-efficient and powerful

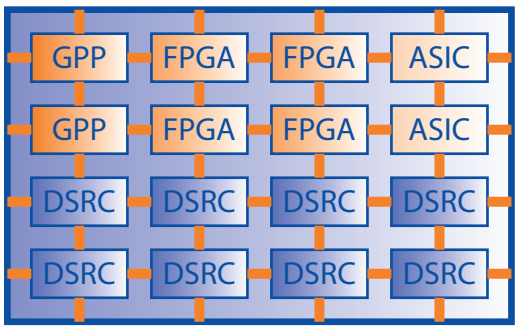
*Paul Heysters*

***The handheld devices of the future must perform multiple functions while consuming an absolute minimum of energy. These contradictory demands are reason enough for Paul Heysters to design systems able to reconfigure themselves, depending on the environment and system requirements. Hardware that can adapt itself to the tasks at hand. A new breed of 'chameleons' is born.***

"We have been theorising about the 'handheld device' of the future, an apparatus that can replace a number of existing devices by combining functionality, and thus assist the traveller in various kinds of ways, anywhere he or she goes. It will have to offer location-specific features and have highly personalised functions. It therefore has to adapt to the environment it is currently in, and most importantly: all that functionality has to be guaranteed using a minimum of energy. Advances in the battery industry are much slower than they are in the semiconductor sector, so you cannot expect a solution to come from that side."

"Of course you can use a powerful 'all-purpose' Pentium 4 processor to combine many functions, but this processor devours a lot of wattage. You do not want that mini-oven heating up your pocket! In laptop computers, Intel has opted for strategies to lower energy consumption, and it has developed a 'mobile' version of this processor. They use techniques like lowering the power supply voltage and slowing down the clock whenever possible. This yields some energy reduction, but the real solution is to be found in a chip architecture of a completely different type. For many systems, energy consumption is not an issue at all, and it is apparent from the way systems are designed."

"Let's take a handheld computer that must be able to use wireless standards like WLAN, UMTS and Bluetooth. For every standard, you can include separate hardware that is co-ordinated by a processor. But then again: if a new UMTS version is introduced, you must have to replace a very expensive dedicated chip. What we want to do is adapt the hardware to the environment and needs. If you are in an UMTS environment, the hardware will be adapted to




***Examples of current projects:***

- EYES: Energy Efficiency Sensor Networks (EU / FP5)
- Chameleon: Reconfigurable computing in hand-held multimedia somputers (NWO / PROGRESS)
- Adaptive Wireless Networking (Freeband Impulse, Ministry of Economic Affairs)
- GECKO: Communication and scheduling in reconfigurable multimedia terminals (NWO)

calculate all things needed for WLAN access; using Bluetooth results in a selection that is only partly the same. Our solution for this is a ‘tiled’ chip, consisting of separate tiles, each with their own functionality. We have included Digital Signal Processing on the chip, and we have developed a smart processor called ‘Montium’. This is a species of chameleon from Cameroon: the entire project of reconfigurable hardware is also called Chameleon. We have enough power in the tiled chip for demanding applications like sound and video.”

“One tiled chip can contain several Montiums and DSPs. A selection of tiles is made for a given application and then the other tiles can be completely switched off. Another function may demand more processing power, and you can switch on an additional Montium again. In that way, you only use the part you need. That is certainly not the case when you use a conventional ‘work horse’ processor. We found out that in terms of energy consumption, it is very expensive to move signals outside of the chip, so you have to find ways to maximise on-chip communication. In conventional computer architectures, data is sometimes moved along the communication bus six or seven times before the action takes place. Avoiding this, you can gain a lot. Or in fact lose a lot.”